FACT SHEET

UNITED STATES AIR FORCE

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The Airborne Laser

FREQUENTLY ASKED QUESTIONS

What is the Airborne Laser?

The Airborne laser (ABL) is a uniquely modified 747-400 freighter aircraft designed to shoot down ballistic missiles during their boost phase.

How does it work?

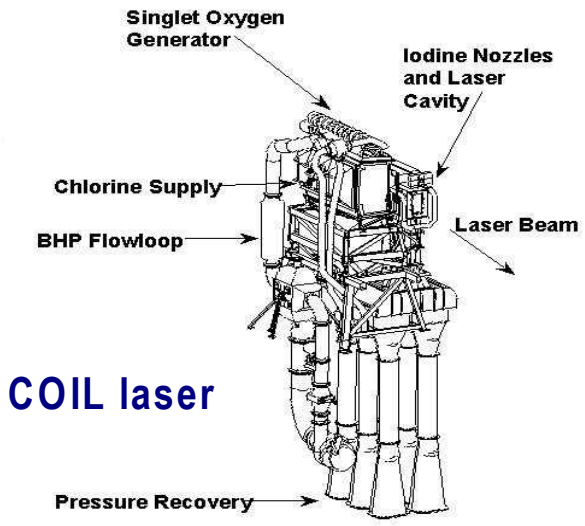
ABL uses four lasers, an advanced optical system, a series of sensors, and a state-of-the-art computer system to find, track, and destroy ballistic missiles. To do this, system components operate in a specific sequence. First, its infrared sensors detect a boosting missile. This information is relayed to a kilowatt-class laser – located on the aircraft's distinctive hump – that finds the missile, reports basic data such as range, speed, and altitude, and begins tracking it. The next laser to fire is located inside the aircraft. Called a Tracker Illuminator Laser, it sweeps the missile with its beam, locks onto it, and determines the spot where the high-energy laser will be aimed. The third laser, the Beacon Illuminator Laser, bounces a beam off the missile back to the aircraft. This measures the amount of atmospheric disturbance between the aircraft and the missile, a condition that must be compensated for using the adaptive optics system. Finally, the high-energy laser, in this case a series of modules comprising a megawatt-class Chemical Oxygen Iodine Laser, is fired. The high-energy laser beam heats the missile body enough to cause its skin to crack. Since the missile is fueled and under pressure, it explodes, dropping its payload on or near the launch point.

What is a COIL and how does it work?

Scientists at the Air Force Research Laboratory at Kirtland Air Force Base, New Mexico, invented the Chemical Oxygen Iodine Laser (COIL) in 1977. Since then, its size has been significantly reduced and its power output significantly increased. The COIL utilizes industrial strength household chemicals to produce its power. The first model of the ABL, called YAL-1A (prototype Attack Laser, Model 1A), which is now under development, will have six COIL modules which will be installed in pairs in the rear of the aircraft.

What produces the light that ABL uses to destroy missiles?

Each COIL module has a reservoir of Basic Hydrogen Peroxide. Chlorine gas is injected into the syrupy liquid to produce "excited" oxygen. Iodine gas is then injected into the excited oxygen to produce excited iodine. When the iodine returns to its normal state, it gives off flashes of light called photons. Those photons are amplified to produce the laser beam.



How does the laser beam focus on the target?

The third laser that fires in the ABL engagement sequence, the Beacon Illuminator, bounces a beam off the missile to measure the amount of atmospheric disturbance between the missile and the aircraft. After the amount of disturbance has been determined, a deformable mirror, which has a thin, flexible face, is used to correct for it. Small pistons, called actuators, behind the mirror surface, warp or deform the mirror to pre-distort the high-energy laser beam. As a result, when the high-energy laser beam is fired, its beam leaves the aircraft in a deformed state. But the disturbances in the atmosphere act as a lens so the beam is re-focused by the time it gets to the target. When the beam leaves the aircraft it is about five feet in diameter; by the time it reaches the target, it is about the size of a basketball.

Has this system ever been tried before?

Yes and no. The individual components have been tested numerous times in numerous ways over at least 20 years but they have not yet been assembled and tested as a single system. However, the pathfinder for ABL, the Airborne Laser Laboratory (ALL), shot down five air-to-air missiles in the early 1980s. The ALL was a highly modified Boeing 707 used to demonstrate the feasibility of an airborne laser.

What is the ABL lethal range?
The exact number is classified but the Air Force lists its range as "hundreds of kilometers."

How many "shots" does the laser have?
It depends on the range, the type of missile being targeted, and the amount of atmospheric disturbance.

How many crewmembers are needed to operate the system?
Once the testing phase is complete and extra consoles used for testing have been removed, ABL will have a crew of six. There is a pilot and a copilot, plus a mission crew commander, an airborne surveillance officer, a weapon system operator, and a special equipment operator. On missions, an extra crew can be added because the plane can be refueled in flight and is capable of staying aloft for long periods.

Can the ABL shoot down ICBMs?
ABL was originally designed as a theater weapon to shoot down short- and medium-range ballistic missiles – Scud-like missiles similar to the ones used by Saddam Hussein in the Gulf War. However, the kill mechanism for ABL is applicable to both short- and long-range ballistic missiles. If a boosting missile is within range, ABL could engage and destroy it.

Has the airplane actually flown?
Yes. It made its maiden flight from McConnell Air Force Base in Wichita, Kansas, on July 18, 2002. It made 13 other test flights before being hangared at Edwards Air Force Base, California, where the laser and optical systems will be installed. It is expected to fly again in early 2004.

ABL's first flight
July 18, 2002

What was special about the first flight?
The flight represented the end to a two-year-long modification program and the beginning of the formal test period that is expected to culminate in the shoot down of a ballistic missile in late 2004. It was the most exhaustively modified 747-400F in history and represented the largest military modification to a commercial aircraft ever performed by the workers at the Boeing facility.

What are the visible effects of this modification process?

The most visible is the huge turret that has been attached to the nose – a 12,000-pound rotating device housing the ABL's 1.5 meter telescope that will serve as the lens through which three of ABL's lasers, including the megawatt-class "killer" laser, will be fired.

Since the weapon system was designed to shoot down theater ballistic missiles, will it have enough power to shoot down the longer-range missiles?

Yes. The COIL is a megawatt-class laser, which means in its current configuration of six modules it is designed to generate a million watts or more of energy to destroy a target at a distance of more than 200 miles.

Can you increase this power to make it viable at even longer distances?

Yes, but engineers are still studying ways to do this. One way is to design a more efficient adaptive optics system to better measure the amount of atmospheric disturbance between ABL and the target and more effectively compensate for it. Another is to develop a more precise pointing mechanism to keep more of the COIL beam focused on the aim point. And a third is to find a way to increase the amount of power produced by the COIL lasers.

Are the modules big and bulky?

Yes. Each module is about the size of a SUV turned on its end and weighs about 6,500 pounds exclusive of the plumbing and support equipment. But there are three elements involved when ABL's engineers consider the weight issue. One, indeed, is the weight of the modules themselves. Another is the amount of weight that the flooring can support. And the third is the distribution of the weight inside the aircraft. Engineers are closely watching all three elements, as engineers would do for any aircraft. So far, all three elements are within the technical limits.

There have been reports that ABL may need as many as 14 modules to produce the amount of power needed to achieve its full potential as an effective defense against ballistic missiles. Is this true?

The number of modules is an outdated issue. ABL is less interested in counting modules than in determining the effectiveness of the system, particularly how much power can be put on target as opposed to how many modules it takes to produce that power. With the current configuration of six modules in the prototype aircraft, the amount of power that can be put on target is significant. ABL is a revolutionary system that fills an important gap; it provides a way of boost-phase missile defense that does not exist in any other system. That is not to say it cannot be improved, but improvements would not necessarily depend on the number of modules.

Where at Edwards will the systems be assembled and installed?

GPRA (foreground)
SIL (background)

ABL has its own compound called the Integrated Test Force that is within Edwards' Birk Flight Test Facility. The compound includes an 18,000-square-foot System Integration Laboratory (SIL) where the Chemical Oxygen Iodine Laser will be tested, and a Ground Pressure Recovery Assembly (GPRA) that allows testers to simulate the ABL's operational altitude. ABL also has secured a scrap 747 fuselage where the high-energy laser system will be installed for fit and operation before being disassembled and reassembled on YAL-1A.

What are the "blocks" I have been hearing about?

Blocks are the stages of ABL's development. YAL-1A also is known as the Block 2004 aircraft because it expected to reach the testing stage in 2004, culminating in the shoot down of a Scud-like ballistic missile late in the year. Block 2006 will be the same aircraft except it will be improved as a result of lessons learned during the testing of Block 2004. Block 2008 will be an entirely new aircraft.

How much will ABL cost?

ABL began with a $1.1 billion contract to three major contractors – Boeing, Lockheed Martin and TRW (now Northrop Grumman) – in 1996. Through Fiscal Year 2002, ABL had actually spent $1.7 billion. The appropriation for Fiscal Year 2003 (when much of the segment testing and integration work will take place) is $598 million. The request in the President's budget for Fiscal Year 2004 is $610 million. On projects like this it is not uncommon to experience increases although efforts are made to limit cost growth. This is especially true in ABL since nothing like it has ever been done before and no one is sure what challenges will emerge as the integration and test phases' progress.

Providing the integration and test phases run smoothly, when will the ABL be ready for use?

Currently, ABL is scheduled to shoot down a Scud-like ballistic missile over the Pacific Ocean in December 2004. Theoretically, ABL could be put into emergency use, called Emergency Operational Capability, any time after that.

What protections are being taken to protect the ABL flight crew from suffering eye damage when it fires the high-energy laser against a target?

Any reflection to which the crew may be exposed would be from water droplets in the atmosphere between the aircraft and the target. Wearing special safety glasses, now being designed at an Air Force medical facility in San Antonio, Texas, are expected to be sufficient.

-ABL-

(current as of 24 March 03)